Demand Response Programs for Elderly & Disabled Vermonters

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ACTR
a division of Tri-Valley Transit

Middlebury College

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Overview

Justification of Project

In this project we investigated how rural transportation systems can best support Vermonters who are older and/or disabled. These Vermonters (often referred to in transportation literature as the elderly and disabled (E&D) populations) often face challenges when going about their daily lives. In trying to meet basic needs, such as hospital visits and grocery store runs, they may face challenges like the lack of a car, the inability to drive, and more (Public Transit Policy Plan, 2020). In addition, this population faces greater social isolation, which can have negative effects on mental and physical health (Nicholson, 2012). These challenges are exacerbated in rural locales where bus routes touch only the densest population centers leaving many rural homes far from traditional fixed-routes transportation services.

The population of Vermont is aging rapidly and a solid transportation plan ought to be in place that can help the growing E&D population reach essential places like the hospital and grocery store (Public Transit Policy Plan, 2020). These Vermonters cannot be excluded from the basic needs in life, such as food, medical care, and social encounters, because of physical or other mobility challenges. Mobility has become an essential part of Americans lives, and to ensure equity for all Vermonters we must do our best to enable mobility to Vermonters despite the difficulty of doing so in rural locations.

The 2020 Vermont Public Transit Policy Plan is rethinking how the E&D population's needs are met in this rural state. An initial proposal includes a plan called the Personal Mobility Account (PMA) to serve the Vermont E&D population, among others. It can be used with demand response transportation services, which operate with volunteer drivers in their personal vehicles who are dispatched by a public transit service provider—such as Addison County Transit Resources (ACTR)—to the client's home or place of pick up. ACTR and Stagecoach (together Tri-Valley Transit) in central Vermont already have unique demand response systems to serve their E&D populations. We partnered with Mary-Claire Crogan, Community Relations Manager at ACTR, to explore how ACTR's and Stagecoach's demand response programs operate and would fit in with a statewide PMA. Through mapping, a cost and equity evaluation, and program expansion analysis we determined the relative efficacy of each program type and if any of the systems may benefit from implementing a PMA state-wide and in Addison County.

Approaches

Case studies were explored from other rural states to try to provide further insight into rural transportation options. We used census data for Vermont to create demographic maps of age, disability, income, and rurality to show areas with the greatest need for demand response programs and to understand areas where ACTR and Stagecoach may be have room for expansion. Next, we compared ACTR and Stagecoach user data and created maps to display where current ACTR and Stagecoach riders and volunteers are located and where they travel most. In the comparison of the two organizations, we began by focusing on gaining sufficient background knowledge of the existing programs in order to properly compare the counties' options and design the overall structure of our report. We then used the data from ACTR and Stagecoach to look at the cost and equity of each program and how they served their populations.

Next, to help Tri-Valley Transit look to the future, a few growth models were constructed to examine how their services could potentially expand. And finally, given the current situation, we investigated and speculated how COVID-19 may affect public transportation and this project in general.

Background on Demand Response Programs

ACTR:

The Addison County Transit Resources (ACTR) Dial-a-Ride is a system where specialized populations such as the elderly, disabled, and low-income households may request door-to-door rides. If someone can answer yes to one of four questions, they are likely eligible for the program:

- Are you sixty or older?
- Are you disabled?
- Are you visually impaired?
- Are you on Medicaid?

For Medicaid riders, the Department of Vermont Health Access must confirm eligibility on the individual level. As ACTR is a Medicaid Non-Emergency Medical Transportation Provider, Medicaid riders have unlimited rides for medical purposes. For Elderly and Disabled riders, six rides are allocated per month; more than six rides in a month incurs out-of-pocket expense. Rides given usually stay within the county, but specialized care out-of-county or even out-of-state are available. E&D riders may travel 40 miles out of the county a couple of times a year for personal necessities. There are fee-based options for those riders that are not approved, such as Ride Match. Rides through Dial-a-Ride are given by volunteer drivers, organized by on-staff coordinators. There were 39 volunteer drivers that serviced 502 unique E&D clients in the 2019 fiscal year. The sense of community among the drivers is very strong and is one of the distinguishing features of this program.

Stagecoach:

The Stagecoach Ticket-to-Ride program operates within the same demographic of users, with the same criteria for qualification into the program as the ACTR Dial-a-Ride, now that they have been incorporated into Tri-Valley Transit. In the 2019 fiscal year, they operated with a similar number of drivers (31) as the ACTR system, but had far fewer unique E&D clients (139). Previously, Ticket-to-Ride had relied on taxis, but now they have weaned their dependence on this costly mode of transport in exchange for a stronger base of volunteer drivers, which the ACTR system has shown works. Instead of a set number of rides each month, users of Ticket-to-Ride are given a set monetary allowance, and each trip deducts from this balance. The cost for each ride depends on the mode, increases with distance and decreases with more occupants in the same vehicle.

Proposed PMA for Vermont:

The state would like to create a program that is more universal across all the counties that would address the E&D population and ensure their needs are being met. The proposal is called a Personal Mobility Account (PMA), which would allow individuals to make use of public transit

services for whatever trip purposes they desired (Public Transit Policy Plan, 2020). The state would like to ensure that that program is available statewide. This program would make sure opportunities are available in all counties, not just certain places. The funds would initially come from current sources of E&D funding. To support the public funds, private funds may also be added to a personal account by the individual or from family members or friends. For a PMA to be set up and used, "all Vermont transit providers would need to allow for a 'client-pay' billing procedure" (Public Transit Policy Plan, 2020). Once money is deposited, the PMA could be used to pay for trips for any purpose operated by the transit provider. This could include agency vans, volunteer drivers, or a negotiated trip with a taxi. While the public funds are limited, with the PMA, a client could add as much private funds into it as they wish. This model is aimed less at counties that already have robust Dial-a-Ride programs for the elderly and disabled, and more at counties that lack the infrastructure to support their E&D population. This is only a theoretical framework, and specific aspects of the PMA are likely still flexible and open to public input.

Spatial Analysis of Potential and Existing Demand Response Clients

Introduction

In order to gain a better understanding of the current demand response programs and statewide potential, we decided to conduct various spatial analyses. The first set of maps created for the analysis displays where potential elderly and disabled (E&D) riders exist throughout Vermont based on the E&D population, as well the income and rurality of each tract. The second set of maps present the information we had about current riders, volunteers, and trips for ACTR and Stagecoach. These maps were used to aid in the analysis of the different E&D demand response programs and to also show areas of transportation needs within ACTR and Stagecoach's existing service regions and throughout Vermont.

Methodology

Data were taken from the American Community Survey (ACS) 2018 5-year survey based on the US Census data, the 2010 US Census, ACTR and Stagecoach (gathered and provided by Mary-Claire Crogan of ACTR and obtained through email correspondence). The data used for the creation of the maps can be found in the Map Creation Resources and Data folder within the *Final ES Project #1: Demand Response Services* Google Drive folder shared with Mary-Claire Crogan. Data manipulation and map creation were both conducted in R using the Leaflet package (R Core Team, 2019). For the maps looking at demographic information for the entirety of Vermont, the data were aggregated by census tract. For the ACTR and Stagecoach specific maps, the data were aggregated by town and specific locations.

In the creation of the demographic maps, the elderly total and disabled population numbers used were the "best estimates" from the ACS 2018 5-year survey (U.S. Census Bureau, 2014-2018). When creating the maps to display the E&D population throughout Vermont, we

had to make sure to not double count those individuals that are both elderly and disabled. The age breaks in the ACS 2018 data enabled us to add the individuals above the age of 60 with those that were both under 65 years old and had a disability for a preliminary total. This double counts those individuals between the age of 60 and 64 years old with a disability. In order to avoid double counting, we took the provided 60 to 64-year-old population and multiplied it by the estimated proportion of individuals in that age group with a disability.[1] We then subtracted this estimated population of 60 to 64 years old with a disability from our preliminary total to obtain final E&D population counts and population proportions for each of the census tracts in Vermont.

The E&D population count and proportion, along with the median incomes and rural versus urban classifications in each census tract were then displayed in maps to show where demand response programs are needed most. The population (count and proportion) scores and the income scores were based on ten brackets (1-10, with 10 indicating greatest need) and representing the minimum to maximum populations and the maximum to the minimum incomes. The rural versus urban classification score (also 1-10, with 10 indicating greatest need) came from the 2010 census data and is displayed in **Table 1** below. The equation to determine the total demand response need score is as follows: E&D Population (Count or Proportion) Score (1-10) + Median Income Score (1-10) + Rurality Score (1-10) = Total Demand Response Need Score (1-30). Higher scores indicate a higher need for demand response programs. The inclusion of income and rurality in our demand response need scores comes from transportation literature showing that individuals with lower incomes may be more likely to use or need public transportation and those in more rural areas have less access to more common public transportation methods and thus require alternate forms, such as demand response programs (Clifton and Lucas, 2004).

In order to view all of the maps together with the greatest detail and interaction, we encourage you to visit: https://acmillerdata.shinyapps.io/ENVS401/.

Table 1. Primary RUCA Codes, 2010

Description	Score
Metropolitan area core: primary flow within an urbanized area (UA)	1
Metropolitan area high commuting: primary flow 30% or more to a UA	2
Metropolitan area low commuting: primary flow 10% to 30% to a UA	3
Micropolitan area core: primary flow within an Urban Cluster of 10,000 to 49,999 (large UC)	4
Micropolitan high commuting: primary flow 30% or more to a large UC	5
Micropolitan low commuting: primary flow 10% to 30% or more to a large UC	6
Small town core: primary flow within an Urban Cluster of 2,500 to 9,999 (small UC)	7
Small town high commuting: primary flow 30% or more to a small UC	8
Small town low commuting: primary flow 10% to 30% to a small UC	9
Rural area: primary flow to a tract outside a UA or UC	10

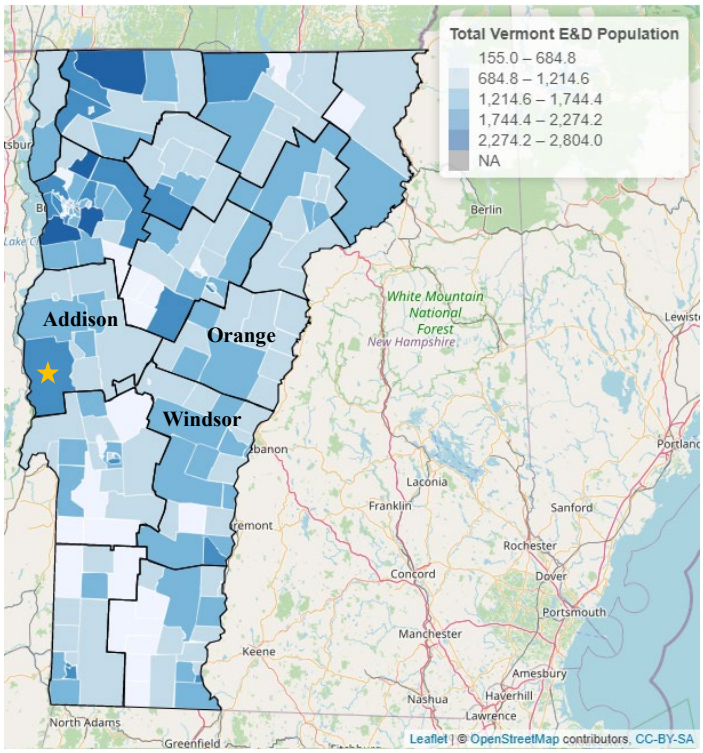
[1] Estimated proportion of individuals with a disability in the 60-64 age group was calculated by dividing the ACS 2018 population best estimates of individuals between the age of 35 and 64 with a disability by the total population best estimate for individuals in this same age bracket. Multiplying this proportion by the 60-64 age group would most likely result in a slight underestimate of individuals with a disability and when subtracting this from the preliminary total would result in a slight overestimate of the total E&D population. With the updated census information in the coming year, this information can be verified and updated.

Spatial Analysis of Potential Riders

Many of the following maps look at the entirety of Vermont. This was done so that these maps could be used in other areas of Vermont to better understand the need for demand response programs there. The primary focus of our spatial analysis is on the regions served by ACTR and Stagecoach: Addison, Orange, and North Windsor counties.

Figure 1 displays the total elderly and disabled population in each of Vermont's census tract. The E&D populations ranged from 155 to 2,804 people per tract. The map to the right, **Figure 1B**, shows each census tract with a score of one to ten based on their E&D population. Within the areas served by ACTR and Stagecoach, the census tract of the highest population and therefore score, is in the southwest corner of Addison county. It is important to note that these E&D population counts do not consider other aspects of the census tract, such as the total population or area.

A



B

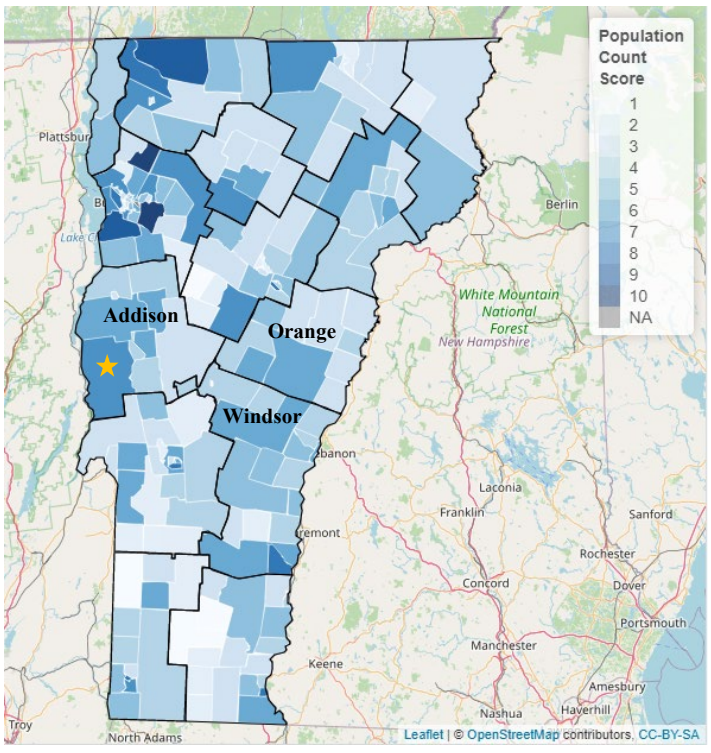


Figure 1. Vermont's E&D Population (by census tract) A) E&D population per census tract and B) Population count score which will contribute to the total demand response need score. Areas in darker blue show higher populations and, thus, greater need for demand response programs. Starred census tract shows the area within ACTR and Stagecoach territory with the highest E&D population count and score. Maps created in Spring 2020 and based on ACS 2018 5-year data.

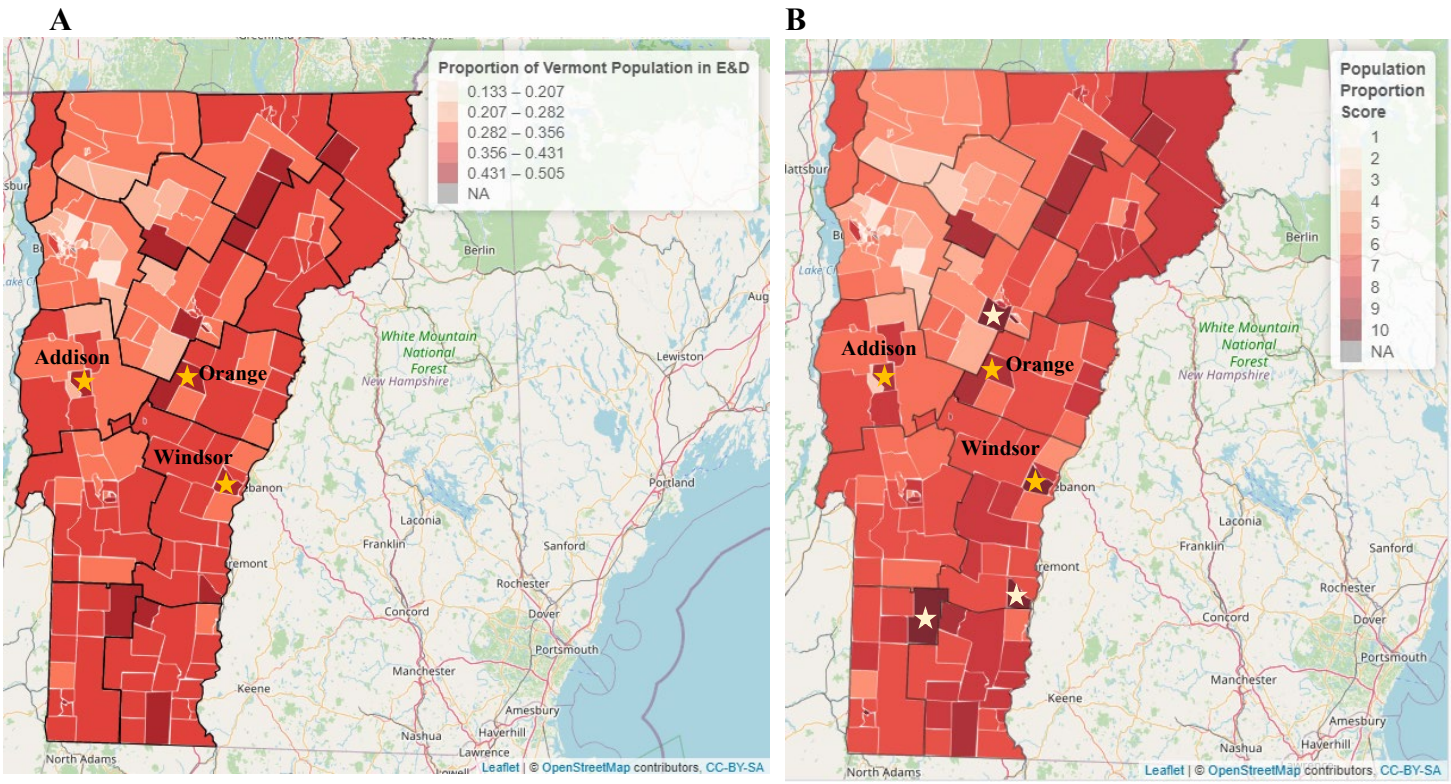


Figure 2. Proportion of E&D Vermonters (by census tract) A) E&D population proportion of total population per census tract and B) Population proportion score, which will contribute to the total demand response need score. Areas in darker red show higher population proportions and, thus, greater need for demand response programs. Dark yellow starred census tracts show the areas within ACTR and Stagecoach territory with the highest E&D population proportion and score. Light yellow starred census tracts show areas throughout the rest of Vermont with the highest population proportion score. Maps created in Spring 2020 and based on ACS 2018 5-year data.

Because the population counts displayed in **Figure 1** do not take into account the total population, it is important to compare those maps to the ones in **Figure 2**, which consider proportions of the population instead of population counts. **Figure 2A** shows the raw proportions of E&D Vermonters in each census tract. The smallest percentage is 13.3% E&D individuals of the total population and the largest is 50.5% in the northeast corner of Bennington county. In **Figure 2** dark yellow starred census tracts show the areas within ACTR and Stagecoach territory with the highest E&D population proportion and score. Light yellow starred census tracts show areas throughout the rest of Vermont with the highest population proportion score. Compared to Figure1, there are three new starred census tracts, one in each county served by Tri-Valley Transit. There are several other census tracts in Bennington, South Windsor, and Washington counties that receive population proportion scores of 10 and these should be considered as areas of focus for the public transportation organizations in those areas. Vermont's Long-Range Transportation Plan points out Vermont's growing elderly population, but these maps highlight that Vermont already has a large elderly population in all of the counties, showing the great need for demand response services right now.

Figure 3A maps the median household incomes throughout Vermont, while Figure 3B shows these incomes converted into an income score that will be a part of the total demand

response need score. Lower median household incomes translate to higher income ***scores*** (because of higher need). This is why, unlike in previous maps, the two maps displayed below appear to be almost opposites of each other. Most of the census tracts within Addison, Orange, and North Windsor counties fall within the bottom three median income ($) brackets and have income scores primarily in the 6-8 range. The only census tract with a score above these, and thus a lower median income than the other areas served by ACTR and Stagecoach is located in the northeast corner of Orange county and is starred in **Figure 3B**. Additionally, the entirety of Essex County should be a focus for public transportation services as all of the census tracts in the county have income scores of 9 or 10.

A **B**

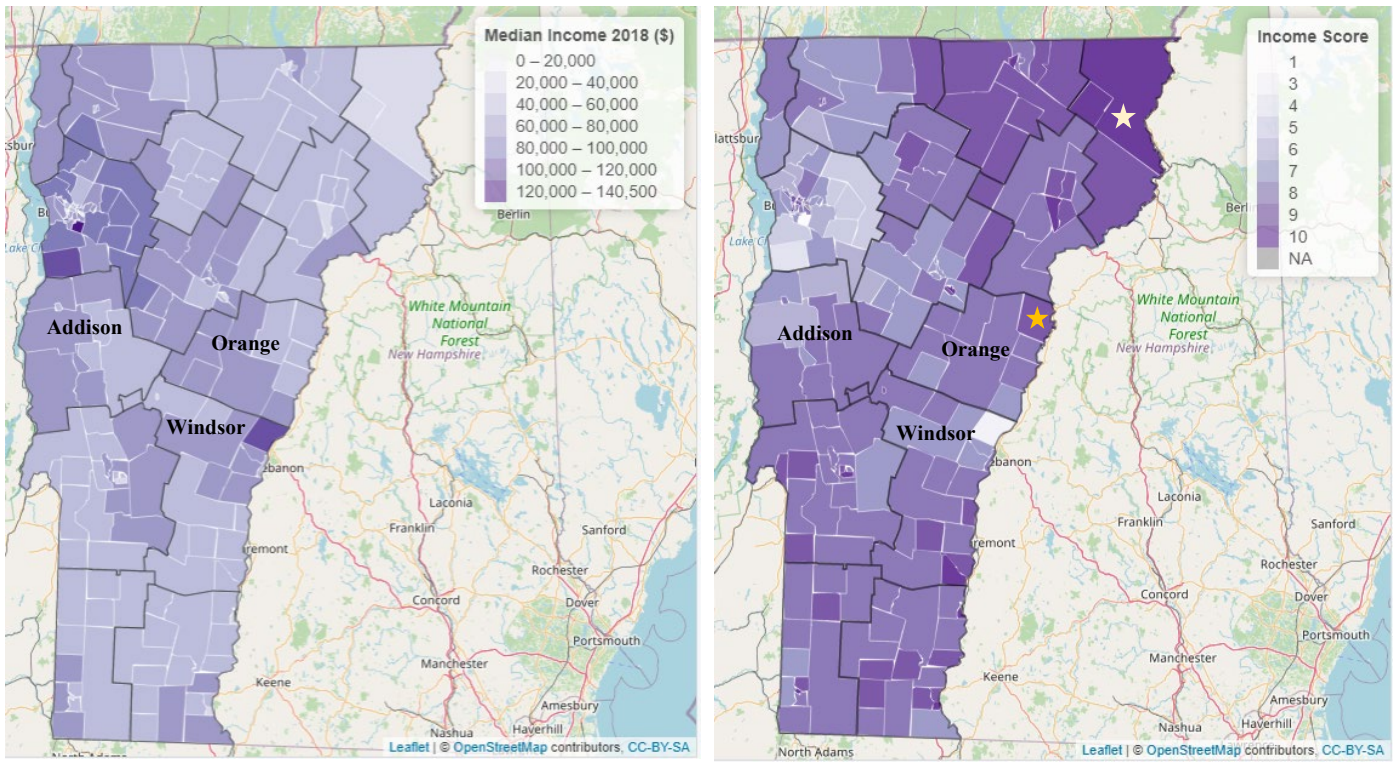


Figure 3. Vermont's Median Income (by census tract) A) Median Income ($) and B) Median income score, which will contribute to the total demand response need score. In A) areas in darker purple show higher median incomes which translate to light purple in B), where darker purple signifies a lower median income and higher income score, and thus more of a need for demand response programs. Dark yellow starred census tract shows the area within ACTR and Stagecoach territory with higher income scores. Light yellow starred region shows areas with the highest income scores throughout the rest of Vermont. Maps created in Spring 2020 and based on ACS 2018 5-year data.

The final map to consider before looking at the total scores is the rural versus urban classification throughout Vermont (**Figure 4**). As reference, the score descriptions can be found in **Table 1** in the methodology section above. Most of Vermont is considered relatively rural and so it should come as no surprise that the majority of the areas served by ACTR and Stagecoach were given scores of 10. Rather, the important sections of this map are the areas that are not receiving higher rurality scores because these areas can be better served through fixed-route systems than more rural areas and therefore, have less of a need for demand response systems

than the more rural areas throughout the state. Specifically, the northern sections of Addison County have scores of 2 because of their proximity to Burlington. Similarly, there are several census tracts in Orange and North Windsor that received a rurality score of 5. Additionally, the two census tracts in the center of Addison County containing parts of Middlebury both have a classification of 7.

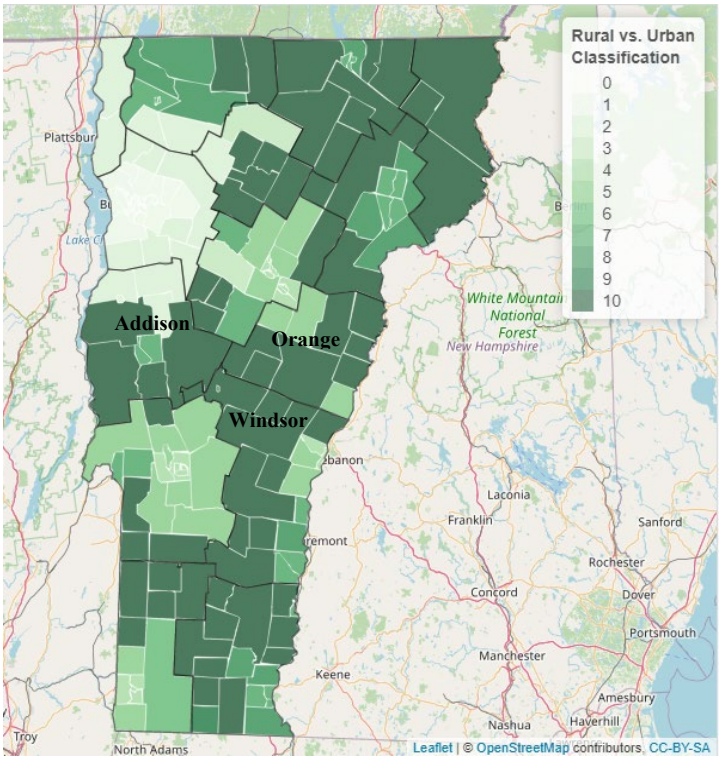


Figure 4. Vermont's Rural versus Urban Classification (by census tract) Rurality scores, which will contribute to the total demand response need score. Areas in darker green signify higher rurality in a given census tract, and thus more of a need for demand response programs. Map created in Spring 2020 and based on 2010 US Census data.

Adding E&D population count, median income, and rurality scores yields a total demand response need score, as shown in **Figure 5.** The result is that the only area within the ACTR and Stagecoach regions that falls within the highest score bracket is the same census tract in the southwest corner of Addison county that had a high E&D population count (star in **Figure 1).** The remaining census tracts fall mostly in the next two need score brackets. The main takeaway from this map is that ACTR should focus some efforts on improving the awareness and reach of their Dial-A-Ride demand response program in the southwest region of Addison County. Throughout the rest of that state, areas of focus are the northern census tract in Orleans County and southern census tract in Lamoille County (stars in **Figure 5**).

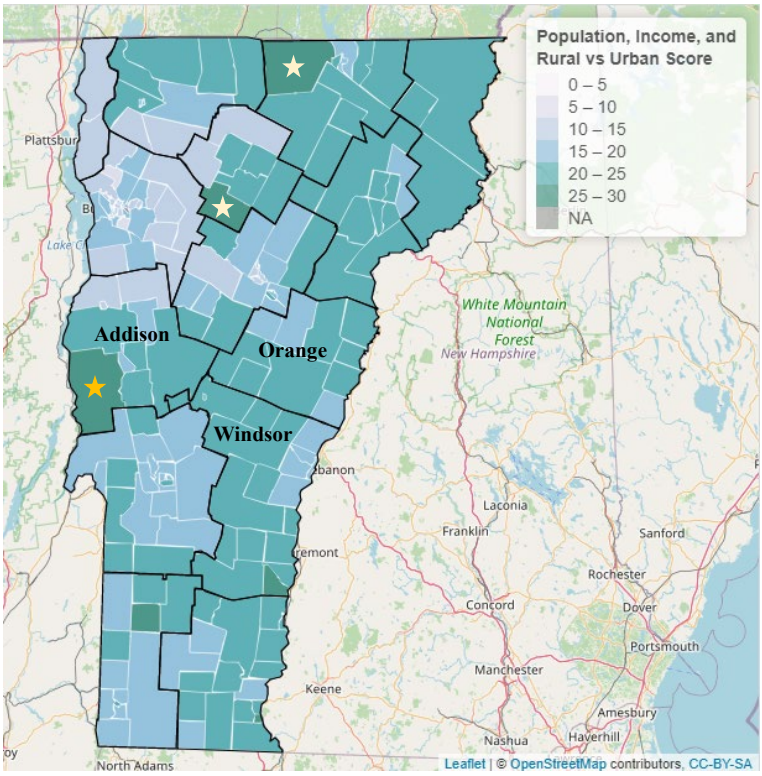


Figure 5. Total Demand Response Need Score (Population Count) Based on population count from Figure 1B, median income from Figure 3B, and rural versus urban classification from Figure 4. Dark green-blue indicates areas of highest need for demand response programs. Dark yellow starred census tracts show the areas within ACTR and Stagecoach territory with the highest demand response need scores and light-yellow starred census tracts show other areas throughout Vermont with the highest demand response need scores. Maps created in Spring 2020 and based on ACS 2018 5-year and 2010 US Census data.

Figure 6 displays the total demand response need score based on E&D population proportion (instead of population count). It is evident here that there are substantially more areas in the highest score bracket when the proportion of E&D individuals are the focus, rather than the population count. The census tracts that are starred in dark yellow above are in the highest need for these demand response programs and may be focus areas for ACTR and Stagecoach in the future. This map emphasizes the need for these demand response programs throughout the areas served by ACTR and Stagecoach. The main conclusion to draw from all of these maps is that Addison, Orange, and North Windsor counties are areas with a high percentage of E&D individuals, moderate median incomes, and high rurality.

The regions that are starred in light yellow in **Figure 6** highlight some of the areas around the state with high demand response need scores based on population proportions and reveal how great portions of the state are in need of E&D demand response programs. In conclusion, the red census tracts in **Figure 6** are ideal places for demand response programs where fixed-route bus systems cannot readily meet the needs of the individuals living in those areas.

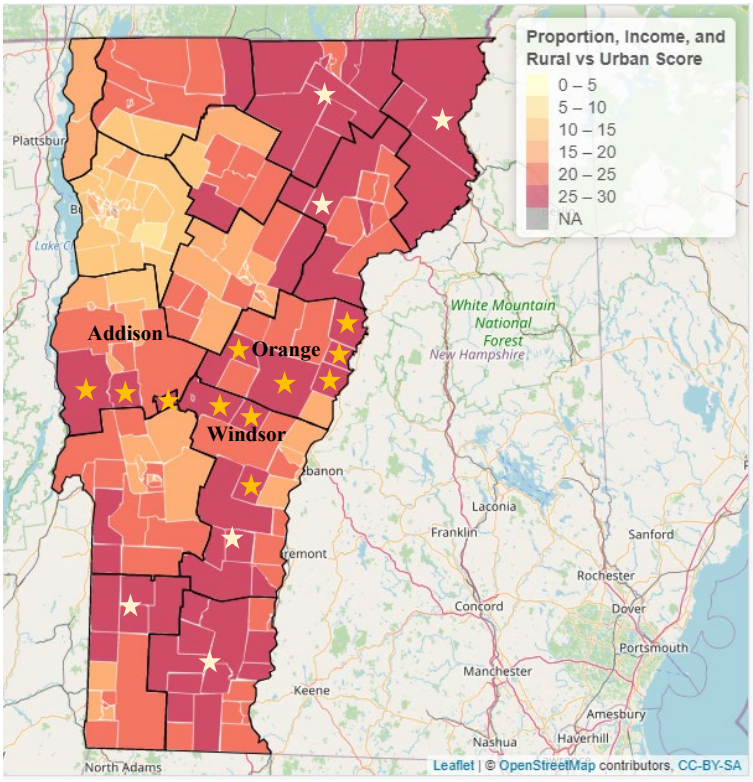


Figure 6. Total Demand Response Need Score (Population Proportion) Based on population proportion (Figure 2B), median income (Figure 3B), and rural versus urban classification (Figure 4). Red indicates areas of highest need for demand response programs. Dark yellow stars show census tracts within ACTR and Stagecoach territory with the highest demand response need scores and light yellow stars show high-need tracts elsewhere in Vermont . Maps created in Spring 2020 and based on ACS 2018 5-year and 2010 US Census data.

Spatial Analysis of Current ACTR and Stagecoach Riders, Volunteers, and Trips

The next set of maps that we created looked at current data from ACTR and Stagecoach. This was done in order to better understand where riders and volunteers come from and where they go. This enabled us to spatially analyze the demand response programs of these two organizations. For the following four bubble maps, the size of the dots had to be modified to best display the information and are relative to each other but not to other groups (i.e., rider dots are relative in size to each other, but not to volunteer dots). Specifics for all of the maps and each of the data points on the maps can be found at the following location: https://acmillerdata.shinyapps.io/ENVS401/.

Figure 7 visualizes what towns and counties riders live in. This map shows all 502 riders for ACTR and all 159 riders for Stagecoach. While ACTR and Stagecoach primarily serve three counties: Addison, Orange, and North Windsor, ACTR also has four riders in Rutland County while Stagecoach has one rider in Caledonia county and two riders in Grafton county (New

Hampshire). For ACTR, Middlebury has the most riders at 195 with Vergennes having the second highest at 78 riders. For Stagecoach, Randolph has the most riders at 28 with Woodstock having the second most at 25 riders.

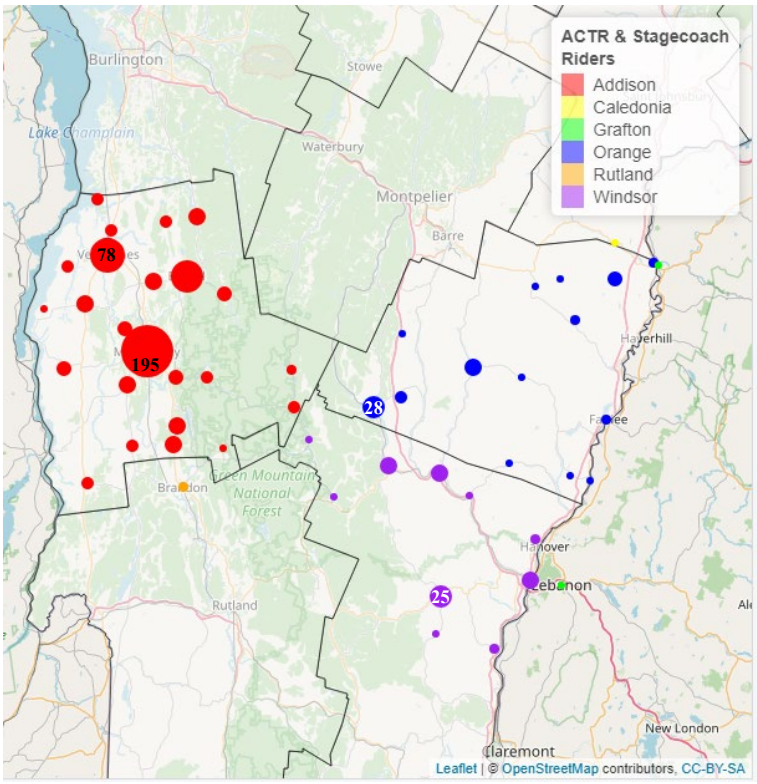


Figure 7. Current ACTR and Stagecoach Riders (by town) Dots represent the number of riders living in a given town. Dot sizes were uniformly modified to best display information and are relative to each other within this map. Examples within several of the data points are to aid in understanding the scale. Map created in Spring 2020 using data gathered and provided by Mary-Claire Crogan of ACTR.

To learn who supports these E&D riders, **Figure 8** shows where volunteer drivers reside. ACTR has 39 volunteer drivers while Stagecoach has 31. Stagecoach, therefore, has almost one driver to every five riders while ACTR has about one driver to every 13 riders. Additionally, Middlebury has the most volunteers with nine, while Randolph has the second most at seven volunteers. ACTR's volunteers appear to be more thoroughly spread throughout the county while Stagecoach's volunteers seem to be more clustered with many centered around southwest Orange county and northwest Windsor county. Because ACTR has a lower volunteer to rider ratio and because the success of the program relies heavily on volunteer involvement, it should be a focus for ACTR to increase their volunteer base in the future. Hopefully, the stories of the volunteers and riders shared in the "Storytelling: Impacts and Outcomes of elderly and Disabled Transit Service" report by our fellow ENVS401 classmates can aid in this goal (2020).

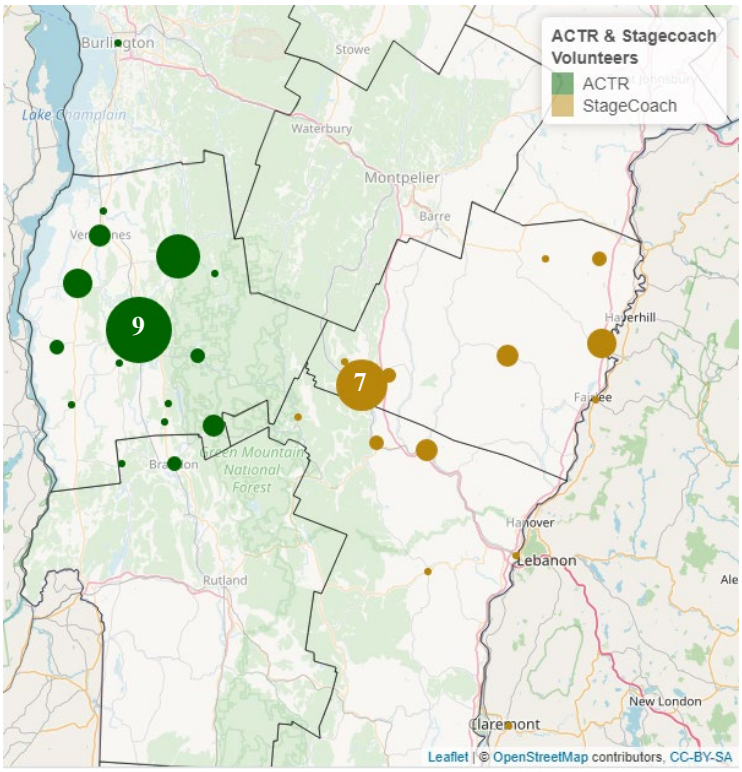


Figure 8. Current ACTR and Stagecoach Volunteers (by town) Dots represent the number of volunteers in each location. Dot sizes were uniformly modified to best display information and are relative to each other within this map. Examples within two of the data points are to aid in understanding the scale. Map created in Spring 2020 using data gathered and provided by Mary-Claire Crogan of ACTR.

Figure 9 shows the top 20 trip locations for riders of ACTR and Stagecoach. The locations are colored by trip purpose with the most popular being medical, food trips, and senior services. Some of these locations are explicitly labeled in **Figure 10**. The map in **Figure 9** show 2,098 trips out of 9,703 total trips in fiscal year 2019 for ACTR and 3,519 trips out of 5,781 total trips in fiscal year 2020 for Stagecoach. This means that the top locations for Stagecoach compose over 60% of their total trips while ACTR's top locations compose roughly 22% of their total trips. Based on this, ACTR seems to have a higher diversity of their trip locations than Stagecoach. Additionally, ACTR's most popular trip destination is UVM Medical Center and most of ACTR's trip purposes are centered around medical, food, or shopping. All of ACTR's out of county trips are for medical purposes, while the remaining top trip locations are mainly in Middlebury. This demonstrates how most of the ACTR riders stay local for services other than medical. For Stagecoach, their most popular trip destination is an adult day care and the other destinations are more dispersed throughout Orange and Windsor counties than ACTR's trip destinations. In addition, Stagecoach's trip types include ones not seen in ACTR, such as senior services and work locations for some of the riders.

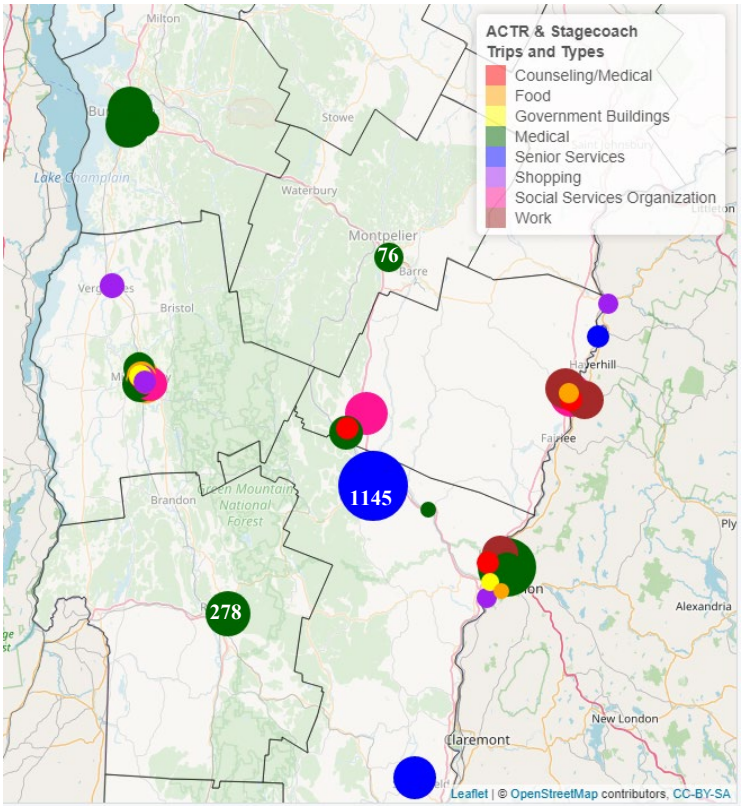


Figure 9. Top 20 Trip Locations for ACTR and Stagecoach (by type) Dots represent the number of trips taken to a given location in the 2019 fiscal year. Dot sizes were uniformly modified to best display information and are relative to each other within this map. Examples within several of the data points are to aid in understanding the scale. Map created in Spring 2020 using data gathered and provided by Mary-Claire Crogan of ACTR.

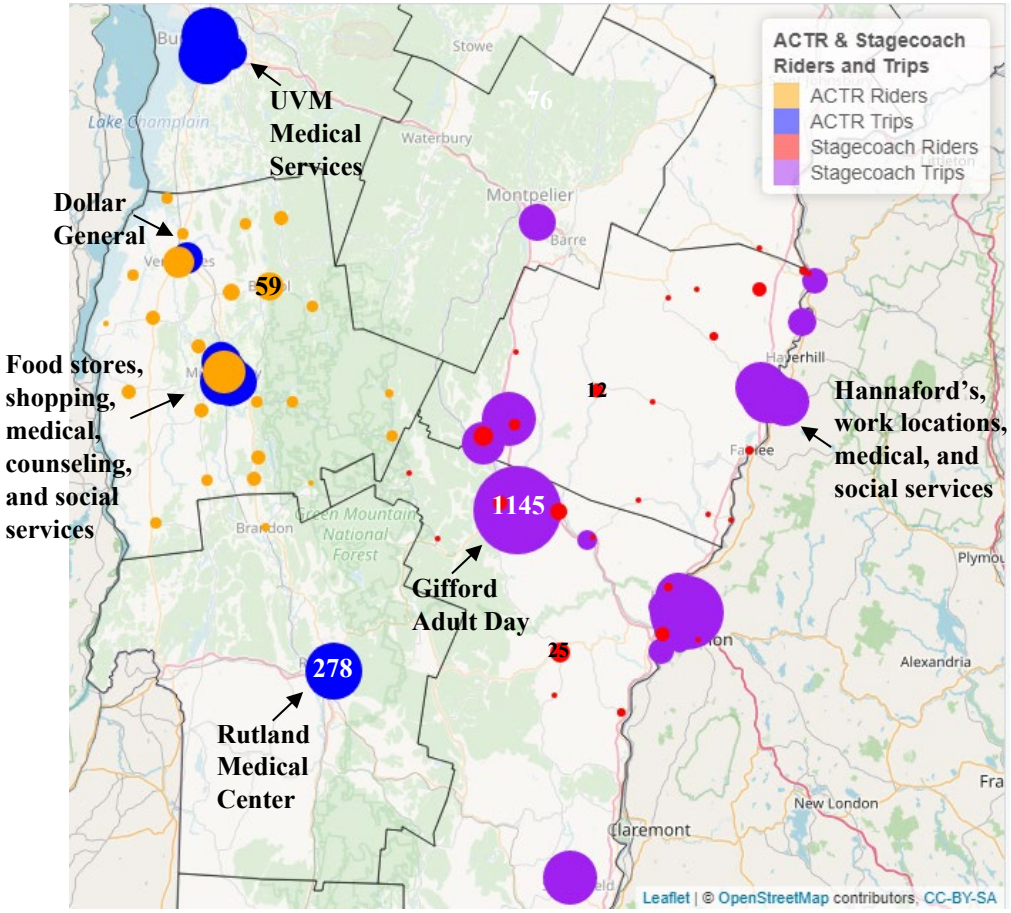


Figure 10. ACTR and Stagecoach Rider Locations and Top 20 Trip Locations Orange and red dots represent ACTR and Stagecoach riders and are relative in size to each other. Blue and purple dots represent ACTR and Stagecoach trips are relative in size to each other, but not to the rider dots. Black numbers within the orange and red dots express the number of riders living in that location and are there to aid in visualizing the scale of the rider dots. White numbers within the blue and purple dots express the number of trips taken to that location in fiscal year 2019 and are there to aid in visualizing the scale of the trip dots. Text labels are pointing out some of the top locations for both transit organizations. Map created in Spring 2020 using data gathered and provided by Mary-Claire Crogan of ACTR.

The map in **Figure 10** combines the rider location data from **Figure 7** and the trip locations from **Figure 9**. This map allows us to better visualize the proximity between the riders and their final destinations. The most important aspect of this map is to notice how although most of the riders are dispersed throughout the counties, the trip locations are generally focused in select areas. This is especially true for the ACTR system. For example, 12 of the top locations for ACTR are located in Middlebury but more than 60% of their riders are located outside of Middlebury. This means that for the riders located in Middlebury, their trips to locations in Middlebury are much closer for them than the other ACTR riders in more rural areas. This variance in distance for riders is an important factor of the ACTR system that will be more thoroughly discussed in the next section regarding the equity of the systems.

The final map (**Figure 11**) considers the number of potential riders and the actual riders for both ACTR and Stagecoach. This map helps to display how ACTR is serving a higher percentage of possible riders than Stagecoach. More specifics as to why this occurs will be discussed in the next section. Still, however, these organizations are serving a very small percentage of potential clients. ACTR reaches roughly 3.9% of potential riders while Stagecoach serves approximately 0.6% of potential riders. It is important to note that not all those who qualify as E&D will need the service, but more than 3.9% and 0.6% of the E&D populations served by these organizations are typically in need of demand response services (Geiger, 2013). Moreover, the number of individuals that could benefit from a demand response program can only be expected to grow with the estimated increase in older Vermonters in the coming years.

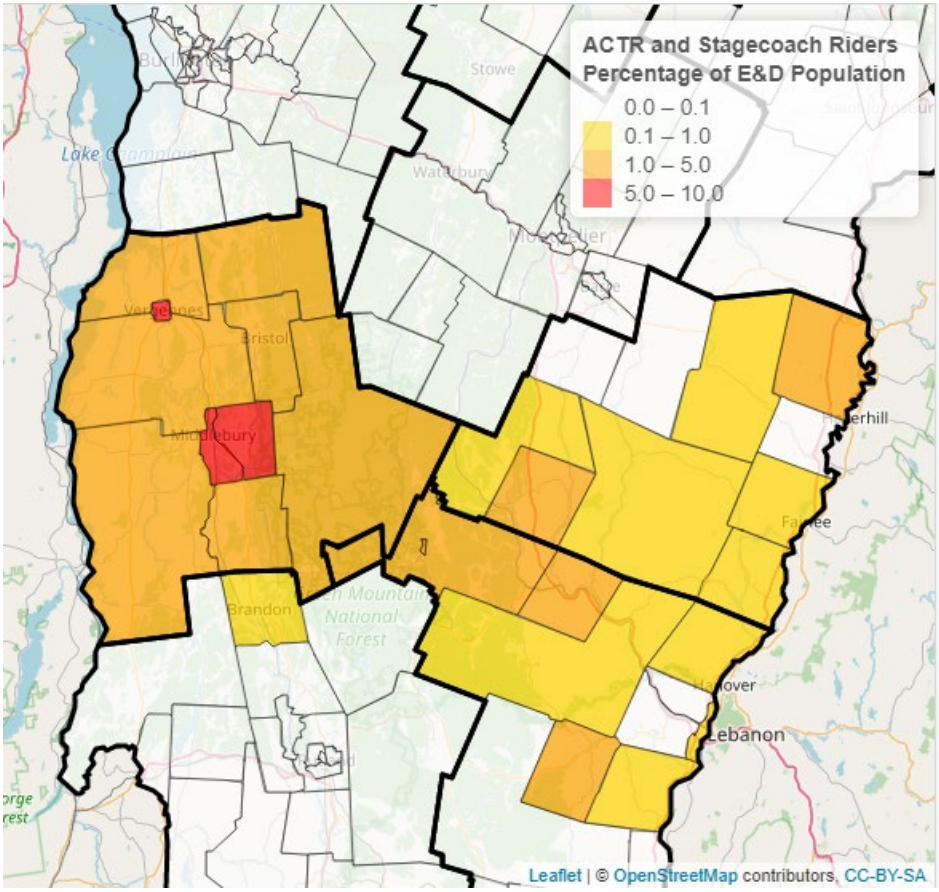


Figure 11. Current Percentage of Potential Riders Served by ACTR and Stagecoach (by census tract) Areas in red represent a higher percentage of riders served. Percentages calculated by dividing the number of current riders in each census tract by the total E&D populations in the areas served by ACTR and Stagecoach respectively. Maps created in Spring 2020 using ACS 2018 5-year data and data gathered and provided by Mary-Claire Crogan of ACTR.

Spatial Analysis Conclusions

In conclusion, the spatial analysis conducted with the demographic information, median income, and rurality in Vermont's census tracts display the great need for demand response programs throughout Vermont, but specifically in areas served by ACTR and Stagecoach. Additionally, the maps created with the ACTR and Stagecoach data help to display how ACTR brings more riders to more places, but could benefit greatly from more volunteers. Another important takeaway is the variation in trip distance, especially for riders that are located further away from their destination. Finally, ACTR serves a higher percentage of potential riders than Stagecoach. In the next section of the paper, this information will be explored through the lens of the two programs' structures and will be used to make recommendations on which program could most cost effectively and equitably serve the E&D population of both Addison county and Vermont in general.

ACTR and Stagecoach Evaluation

In order to understand the different programs that are currently operating, this evaluation seeks to use a number of metrics to compare ACTR and Stagecoach (STSI) in terms of costs and equity. In **Table 2** ACTR E&D Dial-a-Ride and STSI E&D Ticket to Ride programs are compared for the fiscal year 2019. We expect 2019 to be a fairly typical year of use for both programs. The comparison includes several metrics to evaluate cost, general ridership, and program scope. The overall expanse of each program is highlighted, the cost of each program is compared by mile, hour and trip, and the programs are compared on a per client basis. In **Table 3** the design of each program is compared.

Table 2. Comparison of cost and client data of ACTR and STSI

		Fiscal Year 2019	
Expanse of Programs	Service	ACTR E&D Dial-A-Ride (DAR)	STSI E&D Ticket to Ride
	Volunteer Drivers	39	31
	Unique E&D clients*	502	159
	E&D trips provided	9,703	5,781
	Total Cost	$259,652	$171,753
	Total E&D miles	333,085	216,868
	Total E&D hours	11,626	5,867
Costs of Rides	Cost / Mile	$0.78	$0.79
	Cost / Hour	$22.33	$29.27
	Cost / Trip	$26.76	$29.71
Annual Per Client figures	Trips / Client	19	36
	Miles / Client	663	1,363
	Miles/ Trip	34.3	37.5

*ACTR DAR clients only enroll once and may or may not use their full allotment of 6 trips per month. STSI TTR has a waitlist of about 80 people; therefore, the registered TTR clients utilize the service more fully than DAR clients.

Table 3. Comparison of ACTR and STSI program design

	Dial-a-Ride	Ticket-to-Ride
Accessibility in signing up	Self-certify	Self-certify
Allotment per client	6 rides per month	Set $$ amount dependent on household and needs
Possibility for clients to increase use of program	Can pay out of pocket for needs that exceed 6 trips/month	Can pay out of pocket if need is greater than then client's allotted amount
Proportion of clients served per eligible population	~1.0% - 5.0% of most towns are served	0.1% - 1.0% of most towns are served

Cost

Overall, the costs of each program were similar. The cost per mile for each program was very similar. The cost per hour for Ticket-to-Ride was higher, likely due to greater use of taxis at the time these data were gathered. If either program were to offer more rides, the cost would greatly depend on the ability to recruit volunteer drivers and riders' ability to pay if using more than their allotted amount.

Equity

To compare the equity of Dial-a-Ride and Ticket-to-Ride we considered per client figures in **Table 2** and **Table 3**. When examining the two programs, it is clear that each client of Ticket-to-Ride receives more trips and goes more miles. We know that Dial-a-Ride has numerous customers that are signed up as clients but rarely use their full allotment of trips per month. If ACTR DAR clients used their full allotment of trips all year, the program would run 36,144 trips. Currently it runs 9,703 trips. That means the program ran 26.8% of its allotted trips in 2019. ACTR has the ability some days to supply more trips, however during times when drivers are less willing or able to drive (winter and night) ACTR cannot supply as many trips. Overall, ACTR does not currently have the capability to run 100% of the trips allotted.[2]

In Table 3 the design of each program is compared. Both programs use self-certification, so both are easy for clients to sign up. This is important for the sake of ease and equity that people can sign up by self-certification rather than with an ID or other mechanism. This ensures fewer barriers to entry. Ticket-to-Ride, however, has a waitlist of roughly 80 people. Finally, Dial-a-Ride allots six rides per month to each client, while Ticket-to-ride gives a dollar amount per month to each household depending on size of household and needs.

The Dial-a-Ride program is able to sign on a larger number and greater proportion of eligible clients, which ensures more equal access to their services. In addition, the allotment of six rides per month ensures that (within Addison County) people who may live further from the hospital or grocery story are not at a disadvantage because the ride is not based on miles. This is very important given what the maps showed about the variance in trip distance between those

[2] As a technical note, the ACTR clients who do not use the service fully increase the number of clients served and therefore lower the per-client statistics (e.g., miles/client, trips/client).

living closer to Middlebury versus in more rural locations outside of town. Given the rurality of much of Vermont, this feature is important so as to be more equitable regardless of geography.

Applicability to the State

The comparison of these two programs could prove useful for further comparisons of E&D programs across the state to ensure counties are effectively serving the E&D residents in their communities. Examining both equity and cost is an important step forward in improving service for the growing E&D population in Vermont.

Personal Mobility Account

Both programs, as shown by demographic trends, would need to expand their service to keep the same proportion of clients served into the future (Public Transit Policy Plan, 2020). As shown in the maps, there are large proportions of E&D residents in these counties, and these numbers are growing. The expansion of the programs could come from both personal funds and government funds for the E&D population especially if campaigns to increase volunteer drivers are successful. The proposed Personal Mobility Accounts could facilitate this expansion.

Vermont's proposed PMA could:

- Ensure better access to and knowledge of demand response programs across Vermont.
    - While ACTR and Stagecoach have accessible and robust programs, the PMA would ensure all counties in Vermont have some type of E&D demand response service.
    - A state-wide program would help spread the knowledge of demand response programs
    - Allow for non-E&D users
- Capture the benefits of the demand response programs like Dial-a-Ride and Ticket-to-Ride.
    - Low cost with volunteer drivers
    - Connections between riders and volunteers and less social isolation for both groups
    - Increased mobility
- Allow clients to utilize a demand response program more frequently
    - A personal account (after exhausting the free rides for the E&D population) could be supported with personal funds or possibly other government funding

Recommendations

Given the benefits of the Personal Mobility Account, and ACTR's robust Dial-a-Ride program, it is recommended that PMAs are used with the Dial-a-Ride system of allocating six rides a month to the E&D population. The PMA can be expanded to non-E&D riders, but the E&D population should have priority over the volunteer drivers.

The Road to Service Expansion

Given that ACTR proved to have a good demand response service, this section suggests expansion efforts to increase the number of riders and trips in line with the demographic trends discussed earlier. While Vermont spends ten times more per capita than its peer states (the other ten states where over 40% of the population lives in rural destinations), Vermont still requires significant fiscal attention from state and federal organizations to meet unmet E&D needs (VTrans PTPP). In order to augment the operations in place, there are a few main strategies towards scaling up operations in the most cost-effective manner. In the Vermont Agency of Public Transportation Policy Plan of 2019, they outline their three main strategies:

- Increasing the funding from existing sources
- Finding new sources/entities to find money
- Reduce the overall cost of service (mostly via attracting a greater volunteer base)

VTrans is responsible for allocating federal and state funds to the rural transit programs across the state. Just this past year, VTrans received roughly 20 million dollars in federal highway dollars, three times more than what they collected from the Federal Transportation Authority, and 8 million in state funds reaped from fuel taxes and car registration fees (VTrans PTPP). As reported in the Vermont Public Transit Policy Plan, VTrans has been notably successful in collecting federal funds for innovative and pilot projects through competitive grants, as they noted in their annual report (VTrans PTPP). Last year they allocated over 4 million dollars towards the E&D demand response programs statewide, representing a substantial chunk of the overall federal pool. Hence, it seems reasonable to assume that under this year's conditions, we could flex the funding system to receive more federal and state dollars to flow through to ACTR's E&D demand response program.

The following analysis is carried out to explore expanded E&D transportation programs made possible under different increased funding scenarios. We show how expenses may vary under different increases in annual vehicle miles traveled (VMT).

Table 4. Project Increases in Operating Expenses for Expanded Mobility Scenarios for ACTR for the Current E&D Population

% Increase In VMT	*15%*	*30%*	*45%*
	Scenario 1	**Scenario 2**	**Scenario 3**
Increase In VMT	49,963	**99,926**	149,888
Total Expenses with additional miles with current costs	$38,948	**$77,896**	$116,844
Total Expenses with additional miles with 20% increase in costs	$46,737	**$93,475**	$140,212
# of Clients supported	75	**151**	226
# of Trips Supported	1455	**2911**	4366

Three different scenarios are projected based on the total VMT for ACTR's demand response program in 2019: a 15% increase in VMT, 30% increase in VMT, and 45% increase in VMT. While we provide three different scenarios, we go forward with the notion that the 30% increase in VMT would be a reasonable assumption based upon the presumed ability of the

program to incentivize more volunteers, and the continued demand from the E&D population. With the approximately 100,000-mile increase in VMT in demand response rides, this would be able to cover a total of 150 new clients and 2,910 new rides for these clients, as shown in the lower section of Table 4. This is on top of the 502 existing clients and 9,703 rides for the 2019 year, an additional 25 - 30% increase of clientele and rides.

Based upon some of the program's metrics explored earlier in the report, this expansion would cost between $78,000 and $93,500 to meet the desired increase in operations. ACTR's total funding from federal, state, municipal, and business sponsors totaled close to $4.5 million last year (Form 990 TVT). Given the economic conditions we are in right now with COVID, local businesses and municipal entities are limited in their ability to allocate extra funding towards local programs like public transportation. Therefore, we predict that state and federal sources will be more flexible relative to business sponsorships. Tri-Valley Transit, being a state agency, may likely experience an increase in funding for the 2020 fiscal year; the Cares Act is planning to unleash $25 billion of additional funding throughout rural transit operations across the country for public transportation (APTA 2020). If competitive grants were to specifically request more attention towards Vermont's E&D population, the ACTR would be positioned well to receive greater fiscal support for the demand response services.

Table 5. Increased funding scenarios for state and federal sources

		State				
Federal	Increases in Funding	1%	2%	3%	4%	5%
	1%	$31,965	$34,749	$37,532	$40,316	$43,099
	2%	$61,147	$63,930	$66,714	$69,497	$72,281
	3%	$90,329	$93,112	$95,896	$98,679	$101,463
	4%	$119,510	$122,294	$125,077	$127,861	$130,644
	5%	$148,692	$151,475	$154,259	$157,042	$159,826

Table 5 specifies the additional funds that would be available with a variety of increases in federal and state sourcing. It shows that in order to reach the sought-after goal of increasing VMT by 30%, ACTR could request only a 3% increase in federal and state funding to meet the projected 20% increased costs; the $95,896 could cover the $93,474 in actual cost. Regarding the federal source, it is the Federal Highway Administration dollars which are most likely to scale up, and for the state, VTrans has a pool of money generated through tax dollars and transit related fees. Ideally, VTrans could slightly increase gasoline taxes and other registration fees to meet this goal for ACTR.

COVID-19 Analysis

The COVID-19 pandemic has brought uncertainty to both this country's social order as well as social programs like public transportation. Unsurprisingly, public transportation in the state of Vermont has been forced to adapt given these unprecedented times.

Mary-Claire Crogan provided insight into how demand has changed since the start of the pandemic. Overall, there has been a "dramatic decline in Dial-A-Ride demand….and...our volunteer driver capacity remains high, although at this point we are shifting toward using volunteers for package delivery only, not passengers." Mary-Claire Crogan also emphasized that critical-need rides like cancer treatment, dialysis, and opioid MAT treatment are still operating. Additional precautions have been undertaken to mitigate the impacts of the pandemic on local communities too. First, riders in at-risk categories have cancelled rides and began self-isolating. Telemedicine has replaced the need for many in-person visits to the doctor's office. Frontline daily staff and riders are also prescreened for symptoms, travel hotspots, and exposure to COVID-positive individuals. ACTR has also started a parcel delivery program that is geared towards providing food for people at home, but this program seems to have little usage.

In the third month of the pandemic, it is still unclear how this crisis will change people's way of life moving forward. Since the programs outlined in this report predominately serve elderly, disabled, and immunocompromised people in Vermont, a return to normalcy must be approached cautiously. In fact, it is likely that the reality of the current day is the new normal (Frieden 2020). If this is the case, then the practices of telemedicine, pre-screening individuals, and lower ridership may have to be reconciled with for an undefined amount of time. However, there is hope that public transportation will sufficiently adapt to the new "normal," as at-risk individuals will continually need support with the existence of COVID-19. Through its implementation of key safety measures and adherence to public health protocols, it appears public transportation programs in Vermont are currently evolving to meet the needs of this time.

Conclusions

There is a growing population of Vermonters who are older and/or disabled, which, given the rural locality of the state, may experience increased social isolation and difficulty getting to essential services if demand response transportation services are not adequate. Therefore, the continued monitoring of demand response programs for Vermonters who are older and/or disabled is essential. Though demand response options for these people are available in Addison county, Orange county and North Windsor counties, additional features like Personal Mobility Accounts and changing social circumstances like COVID-19 can always alter the existing operating structure.

Spatial analysis showed that there are a number of regions within ACTR and Stagecoach service areas and throughout Vermont that have a high need for demand response services based on their E&D population proportion, median income, and rurality. It also showed that there is a variance in the distance traveled by the riders based on their starting location and the trip destination, specifically when considering riders in more rural areas. Lastly, the spatial analysis showed how ACTR is reaching a higher percentage of potential riders than Stagecoach. In addition, Dial-a-Ride proved to be an equitable program that could operate with Personal Mobility Accounts. While Dial-a-Ride and Ticket-to-Ride are robust programs, the implementation of Personal Mobility Accounts would ensure greater access to demand response transportation across all counties in Vermont. Specifically, given that our project partner was ACTR, the maps showed a need for demand response services in Addison county, and Dial-a-Ride is an effective program, we showed that an expansion of Dial-a-Ride through government funds would help serve the growing aging population identified in the spatial analysis.

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